



# *U.S. Navy Spike Missile System: A New Generation of Miniature Precision Guided Weapons*

**Steven Felix  
NAWCWD-China Lake CA USA  
760-939-2887  
Steven.Felix@navy.mil**

Approved for public release; distribution is unlimited.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>01 MAY 2006</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>U.S.Navy SpikeMissile System: A NewGenerationof Miniature Precision Guided Weapons (U)</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>NAWCWD-China Lake CA USA</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>See also ADM401233. RTO-MP-AVT-135, Presented at the RTO Applied Vehicle Technology Panel (AVT) Business Meeting Week in Amsterdam, the Netherlands, 15-18 May 2006., The original document contains color images.</b>					
14. ABSTRACT <b>See the report.</b>					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>	18. NUMBER OF PAGES <b>16</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified - NATO</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



# *Background*

- Engage “asymmetric” aggressors in complex urban and rural environments; weapons have to be high precision, low collateral damage systems to minimize civilian victims
- To meet these needs, a new class of missile system is necessary. It must be a modular, cheap, lightweight, high precision missile system
- This paper will cover system, technology and design approach aspects of the USN Spike missile project, an innovative, low cost, precision guided missile system



# *How We Are Doing It*

- Spike treated like a commodity
- Development
  - Extensive warfighter interaction and validation
  - 80% vice 100% solution and affordable (get most of the capability to the warriors ASAP)
    - ◆ Cost is highest priority design factor
    - ◆ Weight & Volume
    - ◆ Performance
  - Navy - Industry partnership from the start
    - ◆ Navy laboratory team leads system development
    - ◆ Industry partner engineers for high volume manufacturing
- Manufacturing
  - Navy owned data package
  - System Assembler (No traditional prime contractor)
    - ◆ No missile manufacturing expertise required
    - ◆ 2nd & 3rd tier (defense) contractors
  - Smart use of COTS in a military application
    - ◆ Modular design
    - ◆ Add additional capability through spiral developments
    - ◆ Production line set up for change



# *Programmatic Goals*



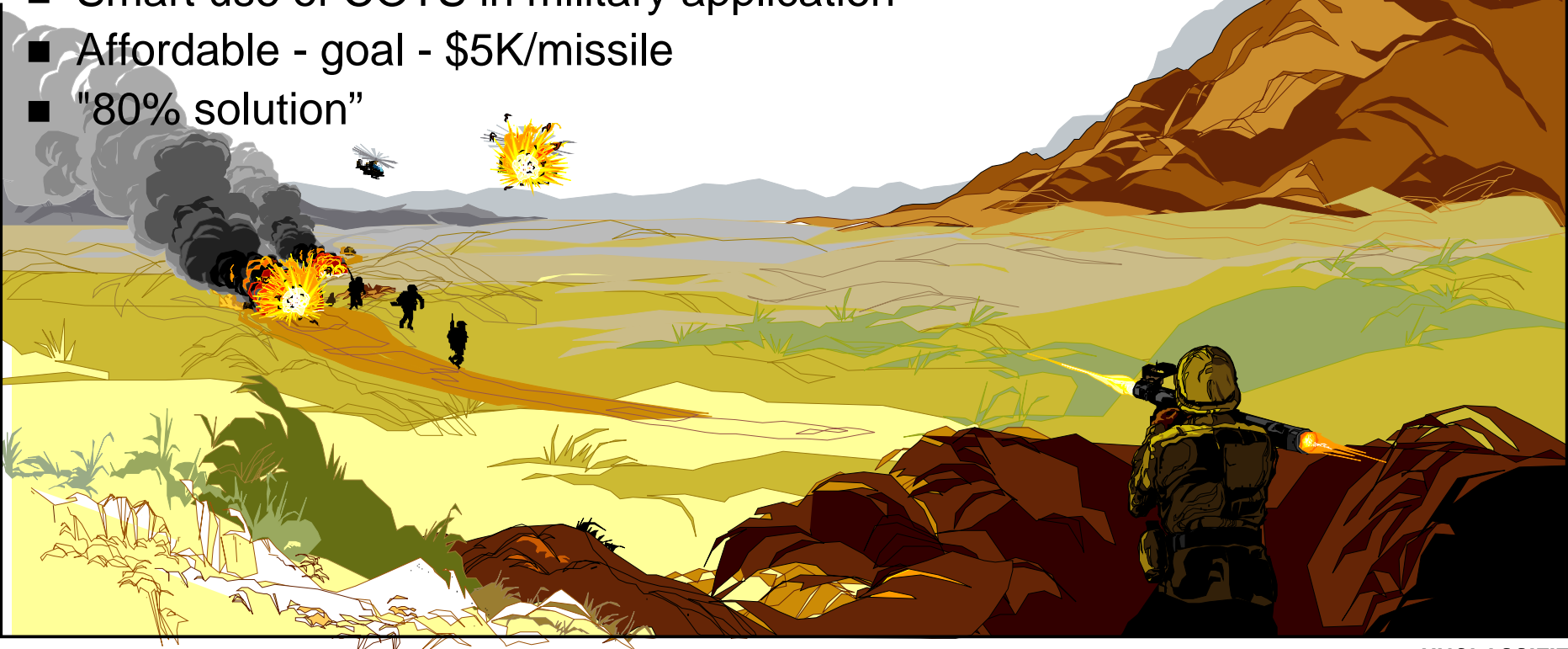
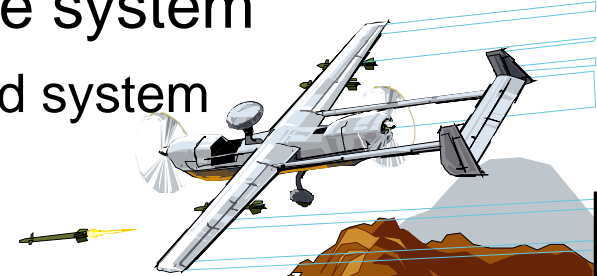
	Spike	Typical
■ X10 reduction in unit cost	\$5K	>\$75K
■ X5 reduction in development cost	\$75M	\$0.5-1.2B
■ X3-4 reduction in SDD time	2-3 years	12-16 years



# *What is Spike?*

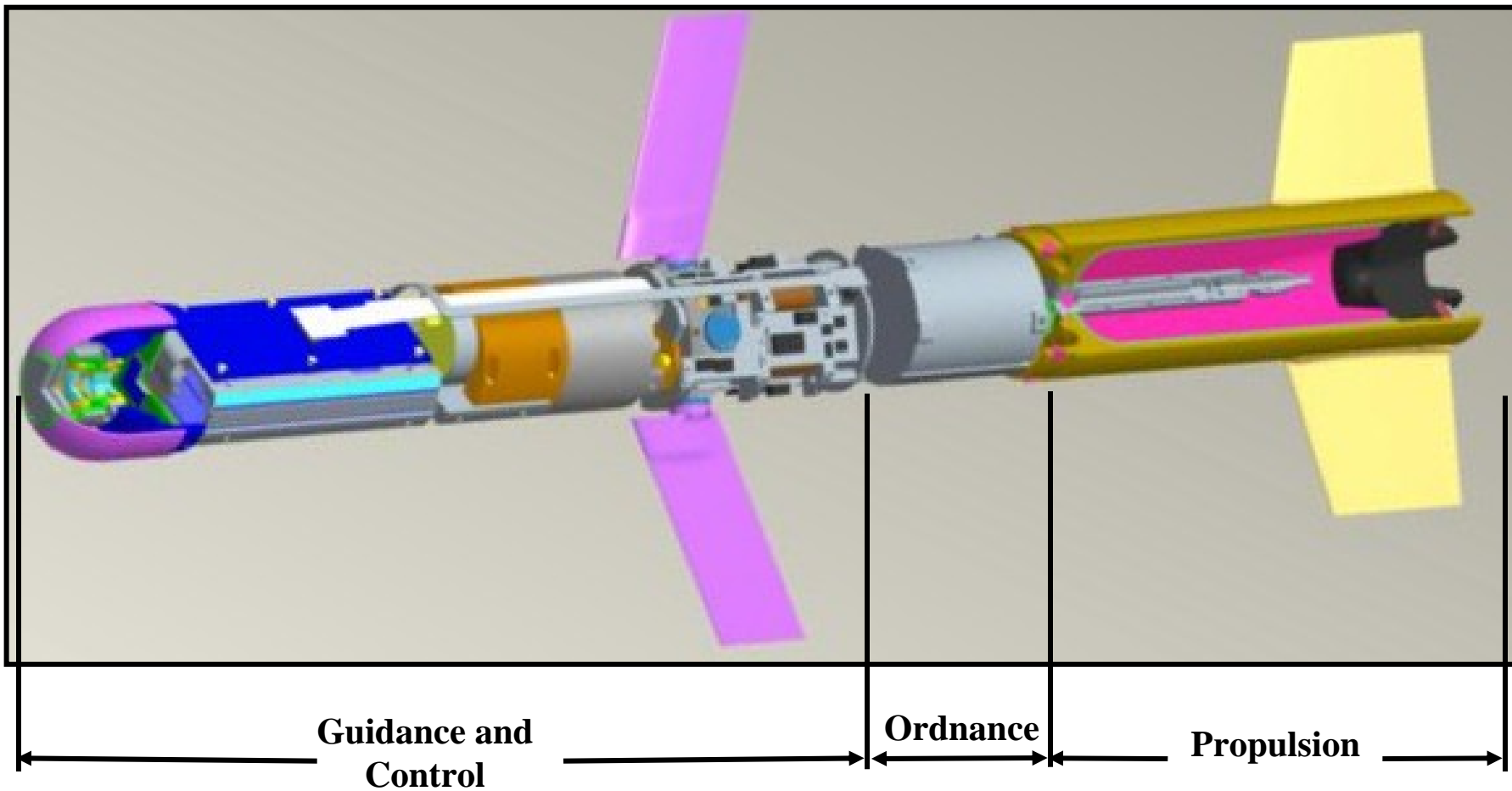
Small fire and forget precision guided missile system

- Shoulder, tactical UAV, or UGV/boat/ship launched system
- General purpose electro-optical (EO) seeker
- Lightweight system - goal of 5 lb./missile
- Smart use of COTS in military application
- Affordable - goal - \$5K/missile
- "80% solution"





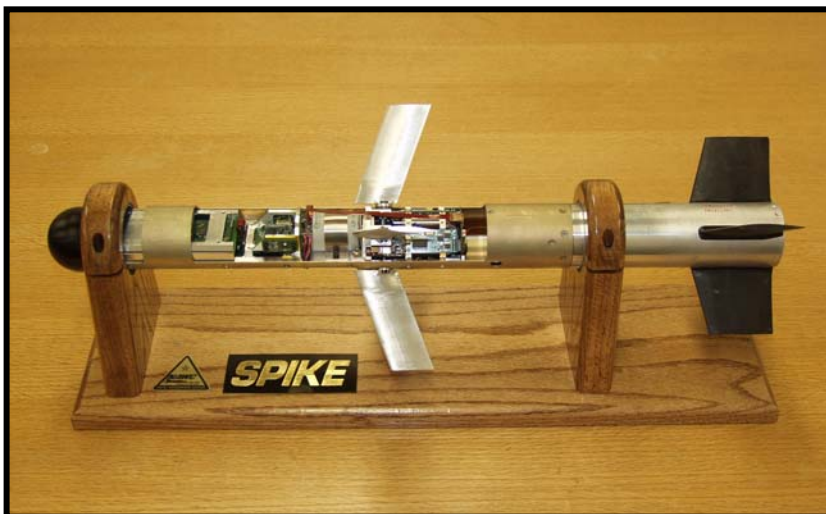
# *Modular System Design*







# *Spike Missile Performance*



## ■ Low Cost Highly Effective Precision Guided Missile

- Total weight  $\approx$  5 lbs
- Warhead  $\approx$  1 lb EFP
- Range  $\approx$  2+ miles
- Max flight velocity  $\approx$  800 ft/sec
- Cost  $\approx$  \$5K AUPC
- Seeker EO or Laser spot

## ■ Highlights

- Fire and Forget
- Fire from enclosure - minimal backblast
- Precision guidance ideal for littoral and urban environments - minimizes collateral damage
- Designed for flexible manufacturing
- Ready for production in 2 years





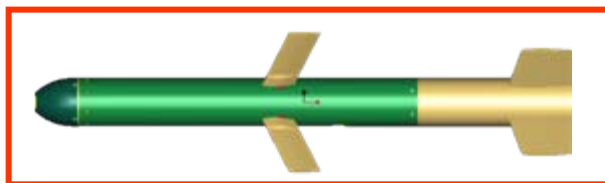
# *Spike Warhead Performance*



- 1 lb. explosively formed projectile warhead
- Copper liner, magnesium and steel fragmentation wrap



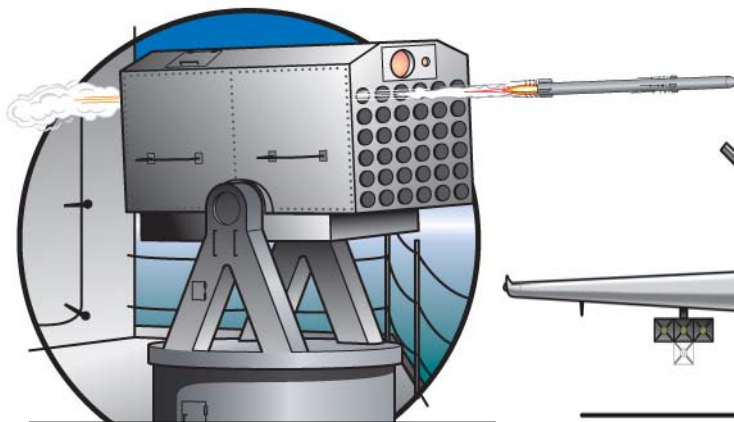
# *Spike Launchers*



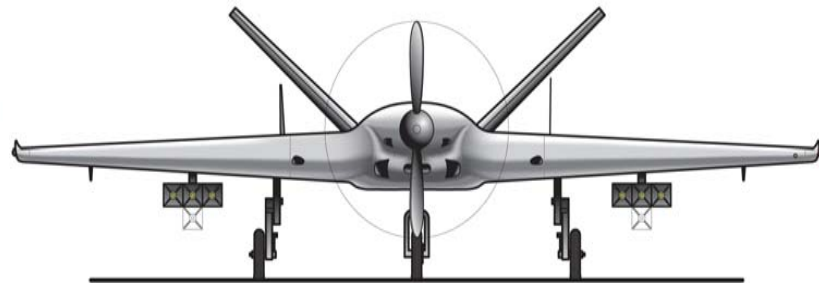
- Common missile
- Multiple launchers



Shoulder



Remotely  
Controlled Box



TUAV



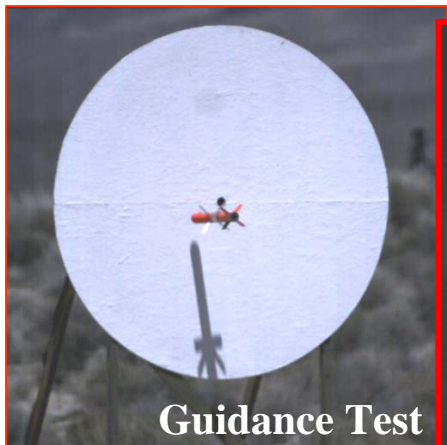
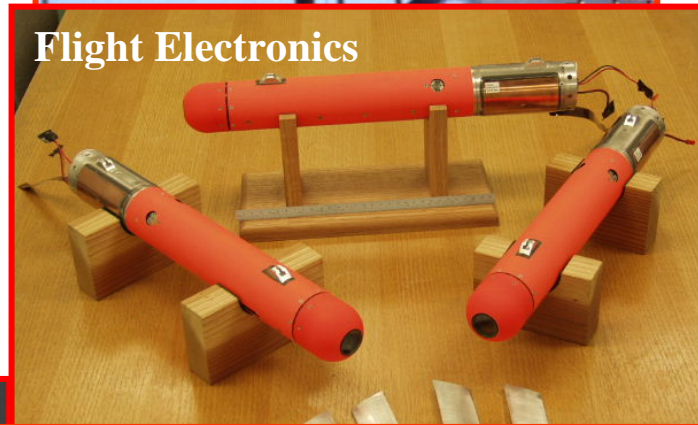
# *Accomplishments*

- Wind tunnel tests
- Target acquisition/track testing
- Preliminary rail launch test firing
- Separation Control Test Vehicle (SCTV) missile firings (3)
- Separation Control Test Vehicle (SCTV) missile firings (2)
- Four warhead lethality tests
- Guided missile test

SCTV Test



Flight Electronics



Guidance Test



Tracker Test



Warhead Test



# ***Asymmetric Threat Target Set***



- Target characteristics
  - Large numbers
  - Low cost
  - mobile
- Targets
  - Small boats
  - Un-armored vehicles
  - Lightly armored vehicles
  - Machine gun emplacements
  - General aviation
  - Helicopters



# *Program Measures of Effectiveness*



- Cost
  - Live fire training
  - Deploy with large numbers
  - Recurring, non-recurring, life-cycle
- Tactical utility
  - Can get it to the fight-weight, volume
  - Value
- Performance
  - Precision guided
  - Low collateral damage
  - Engage maneuvering targets



# *Cost Drivers*



- Control requirements
  - Adequate performance not perfect
- Technology availability
- Control system complexity drivers
  - Lock-on-before-launch (LOBL)
  - Resolved targets
  - Gunner verification of correct target acquisition
  - Results in  $\approx 90\%$  reduction in target acquisition/track processor throughput requirements





# *Technology Trades*



- Strapped down target acquisition sensor
  - Advance CMOS focal plane array (FPA)
  - Fast optics
  - Ultra-stiff airframe
  - Low maneuverability target set
- Simplify tracker/guidance system architecture-low cost
  - Modular electronics design (power, ground, serial data bus)
  - Lock-on-before-launch (LOBL)
  - Gunner target acquisition verification
- Ordnance section
  - Contact only fuze
- Rocket motor
  - Moderate performance
- **Result: low cost missile**





# *Weapon Utility*

- Low enough cost to procure in large numbers for use against low cost targets
- Low cost enough to allow for training
- Light weight (5 lb.) enough to get it to the fight
- Can engage time critical fixed and maneuvering targets
- Precision guided weapon - low collateral damage
  - Ideal for urban battle field and littoral defense
- Easily adapts to several requirements/needs
  - UAV/UGV/USV armament
  - Shoulder launched ground force weapon



# *Summary*



- How we are doing it
- Spike missile system
  - Low cost, light weight, low collateral damage
  - Low cost enough for training
- Flexible use
  - TUAV/USV/UGV/Shoulder
- Provides battlefield versatility for the individual warfighter to engage asymmetric threats